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THREE NORTH AMERICAN CRETACEOUS FISHES

By David H. Dunkle

I. Remarks on *Helmintholepis vermiculatus* Cockerell

Plate 1

The North American Cretaceous fish *Helmintholepis vermiculatus* Cockerell (1919) is based on a single disassociated scale (USNM 8677). The specimen was collected in 1914 by T. E. Willard, of the U. S. Geological Survey, 1¼ miles northeast of Milliken, sec. 13, T. 5 N., R. 67 W., Weld County, Colo., in exposures of the Fox Hills sandstone (Maestrichtian).

The scale, presumably deriving from the left flank of a fish, is comparatively large and, although composed of successive fine lamellae, is of remarkable over-all thinness. The major portion of the apical margin is missing. The outline of that part impressed in the matrix, however, indicates a roughly 5-sided form for the scale. Of these edges the broadly rounded apical margin has the greatest length. The dorsal and ventral borders converge slightly toward each other, anteriorly, to distinct but obtuse basal angles. The basal margin is divided into upper and lower segments by a low, forwardly convex, median lobe. The greatest length of the scale (21.4 mm.) passes along a longitudinal axis a little nearer the dorsal border than to the ventral

one, and the perpendicular of maximum depth (20.9 mm.) is situated far posteriorly in the vertical plane of the dorsal and ventral apical angles.

The nucleus is a concentrated locus on the longitudinal axis of the element, somewhat basal of the middle length of the scale. Surrounding this area in concentric fashion, relatively fine circuli (about 34 in 1 mm.) cover the dorsal, ventral, and basal quadrants of the external surface. No basal radii are evidenced, but suggestive of such structures are a series of sinuous folds in the courses of the circuli, arranged in an anteroposterior line across the median basal field. The circuli terminate, posterodorsally, along a diagonal extending from the nucleus to the middle point of the dorsal border and, posteroventrally, along a more acutely oblique diagonal extending from the nucleus to a point near the ventral apical corner of the scale. The apical quadrant is, thus, a triangular field with a nuclear angle of approximately 120°. The preserved portion of this part is ornamented with short vermiculate markings which in the center of the field are directed more or less longitudinally and on either side of this median area in zones adjacent to the apical diagonals, vertically. Peripherally the anterior terminations of generally longitudinal apical radii, spaced 4.5 to 5 in 1 mm., may be observed. From the comparisons discussed below, it seems feasible to postulate the passage of these radii posteriorly across a missing marginal and hyaline zone to end in notches along the dentate apical margin of the scale.

The scale of *Helmintholepis vermiculatus* cannot be distinguished from anterior flank scales of the upper Cretaceous Pierre shale fishes *Pelycorapis berycinus* Cope (1877) and *Paleoclupea dakotaensis* Dante (1942). From well-preserved specimens in the U. S. National Museum, the skulls, as well as the scales of the latter two genera, are identical. It must be concluded, therefore, that *Helmintholepis vermiculatus* and *Paleoclupea dakotaensis* are synonyms of *Pelycorapis berycinus*. Unfortunately, the generic term *Pelycorapis* does not appear available for the *berycinus* species. Examination was recently made in the American Museum of Natural History of the genotypic specimen, *Pelycorapis varius*, defined by Cope (1874) on the basis of a fragmentary fish from an undetermined horizon in the "Benton" of Kansas. There can be little doubt of at least close relationship, if not even conspecific identity, between *P. varius* and the North American elopid fish *Thrissopater intestinalis* Moodie (1911).

Woodward (1901, pp. 353, 354, 616) early advocated affinity, at least at the family level, between the two species assigned to the generic name *Pelycorapis* (Cope, 1874, 1877), *Syllaemus* (Cope, 1875), *Apsopelix* (Cope, 1871), and *Leptichthys* (Stewart, 1899). *Apsopelix*

from the "Benton" of Kansas is apparently known only by the fragmentary type specimen. No differences can be observed between the scales and vertebrae of this specimen and the corresponding parts of *Syllaemus* and *Leptichthys*. Most authorities (for example, Hay, 1929; Romer, 1945) continue to treat *Syllaemus* and *Leptichthys* as distinct genera, but in addition to their similarity of scale and vertebral structure, no major variation has been detected as yet among available skulls of the two genera. Certainly the North American materials which have been variously referred to either *Apsopelix*, *Syllaemus*, or *Leptichthys* constitute a basically homogeneous group peculiar to a number of marine strata exposed in the Western Interior, which in geologic range seem restricted to the interval between either the late Cenomanian or early Turonian and the Santonian stages of the upper Cretaceous.

Relationship between the *Apsopelix-Syllaemus-Leptichthys* complex of forms and the late upper Cretaceous *berycinus* species is denoted by the common possession of distinctive modifications of the bone pattern of the skull, and by general over-all similarities in body habit, including the structure and relative position of fins. As might be anticipated, on the other hand, certain regularly occurring variations are to be observed. Of these, the proportions of the parts of the visceral skeleton differ and these features may account for the curious apposition of the mandibles commonly displayed by specimens of *Syllaemus* and *Leptichthys*. Further, the scales of the latter two genera have a large and diffuse nuclear field mainly devoid of any ornamentation and, depending on body position, with the apical quadrant covered proximally, either with complete and entirely vertical circuli or with a median hyaline zone. Such comparisons prompt, in at least tentative solution of the problem, allocation of the *berycinus* species to the oldest generic name unquestionably associated with this group, *Apsopelix*.

To be demonstrated shortly in another connection, the compact assemblage of fishes under consideration is of elopine stock. The members, thus, display interesting specializations of the most primitive teleostean stage of morphologic organization. They comprise a distinctive component of upper Cretaceous marine faunas and would seem best interpreted as a line of pelagic plankton feeders.

Sincere thanks are extended to Drs. Bobb Schaeffer, American Museum of Natural History, and Robert W. Wilson, Kansas University Museum of Paleontology, for courtesies in making pertinent materials available. The photograph was made by Jack Scott of the Department of Geology, U. S. National Museum.

II. Reassignment of *Petalolepis? fibrillatus* Cockerell

PLATE 2

The generic name *Petalolepis* first appeared in an unpublished catalog of fish remains from the upper Cretaceous Pläner formation of Saxony, Germany, compiled by Prof. Moritz Steinla. Subsequently in formal description, Geinitz (1868) considered *Petalolepis* a synonym of the elopid genus *Osmeroides* (Agassiz, 1844) and proposed the name *O. divaricatus* for the identical Steinla specimens. Cockerell (1919, p. 173) interpreted the same scales as those of an albulid fish, and finding the name *Petalolepis* available for the reception of the hence reassigned *divaricatus* species, provisionally referred a new American species, *fibrillatus*, to the generic term. Heretofore known only by the one holotypic specimen (USNM 8662), two additional scales of *Petalolepis? fibrillatus* were recently recognized among the national collections of fossil fishes.

The variety and individuality of fish scales have been amply demonstrated through the work of many investigations in all parts of the world. However, when attempts have been made to arrange these exoskeletal elements in developmental series, the resultant trends of structural variation, either parallel, convergent or divergent, appear to cross phylogenetic lines. In direct consequence, serious doubts are entertained by many ichthyologists not only of the ability but also of the use for identifying and naming fragmentary remains of such parataxial nature. Although disassociated fish scales probably never can constitute a completely satisfactory base for precise studies of broad scope, the future clarification of group relationships and corresponding refinement of fish classification, coupled with accumulated factual data concerning development at all ontogenetic and phylogenetic levels, will correct many of the difficulties surrounding the use of scales. Within restricted limits, on the other hand, scales have been proved effective tools. In the present case a new definition of *Petalolepis? fibrillatus* seems justified. The fossil specimens are entirely distinctive in fundamental structural characteristics and are not to be identified with the genotypic *Petalolepis divaricatus* (Geinitz) from Germany. Equally important, they are of potential stratigraphic utility as representative of practically unknown marine faunas from near shore and lagoonal environments for a seemingly short interval of the late upper Cretaceous in North America.

Grateful acknowledgment is offered Dr. R. W. Brown, Dr. Lore R. David, and Mr. Shelton P. Applegate for advice and various other aids. The photographs accompanying this note are the work of Mr. Jack Scott, Department of Geology, U. S. National Museum.

Family Gadidae

Paractichthys,[1] new genus

Diagnosis: A fossil genus distinguished from living anacanthine fishes by the following combination of scale characteristics: proportionately large, subquadrangular form with central oblong nuclear field and single longitudinal median basal sulcus; peripheral basal circuli more or less longitudinal from apical diagonals to basal scale margin; more proximal basal circuli crescentic, paralleling the basal border and rather sharply recurved or acutely angulated on approaching the median sulcus; and short, sinuous apical circuli diverging slightly to the apical scale border from a faint median longitudinal axis.

Type species: *Paractichythys fibrillatus* (Cockerell) (=*Petalolepis fibrillatus* Cockerell, 1919).

Paractichthys fibrillatus (Cockerell)

Diagnosis: The same as for the genus (the only species).

Type: USNM 8662; one disassociated scale.

Geologic and geographic occurrence: Upper Cretaceous Blair formation (middle Campanian, following Cobban and Reeside, 1952) in the NW¼NE¼ sec. 26, T. 21 N., R. 104 W., Sweetwater County, Wyo.

Referred specimens: USNM 14517 from the topotypic horizon and locality in Wyoming; and USNM 21898 from the upper Cretaceous Fox Hills sandstone (Maestrichtian), near Milliken, in sec. 23, T. 4 N., R. 67 W., Weld County, Colo.

Description: Scales generally of moderate size and ranging from examples with equal dimensions to ones longer than deep (measurements, in millimeters: 10–17 long by 9–12 deep). In outline, the elements are subquadrangular, although the apical portion was evidently weak and the posterior border of the scale is usually preserved with an evenly rounded profile. As here interpreted, the dorsal margin displays a lower convexity than does the ventral one. Anteriorly these edges diverge slightly from each other to obtuse basal angles. The basal border is of low forward convexity but displays a prominent notched median lobe. The longitudinal axis is situated nearer the dorsal border than to the ventral, and the perpendicular of maximum depth lies anteriorly near the vertical plane of the basal angles.

The oblong nucleus occurs adapical to the middle scale length, along the main longitudinal axis. Neither basal nor apical radii are present, although a median longitudinal sulcus extending between the

[1] Derived from the Greek *para*, near; *akte*, shore; and *ichthys*, fish; referring to the inferred near-shore habitat occupied by the fish.

basal margin and the nucleus is a prominent structural feature of all known specimens. Circuli are relatively coarse (about 19 in 1 mm.). On the covered portion of the scale the central ones are crescentic, and paralleling the basal border are either sharply recurved or acutely angulated as their courses approach the median sulcus. Peripherally the circuli are more nearly longitudinal in their arrangement and intersect in very acute angles the basal scale margin after only slight median flexure. The exposed apical quadrant has a nuclear angle of from 75° to 80° and is covered with short, sinuous circuli, which are directed backward and slightly away from a faint median longitudinal axis.

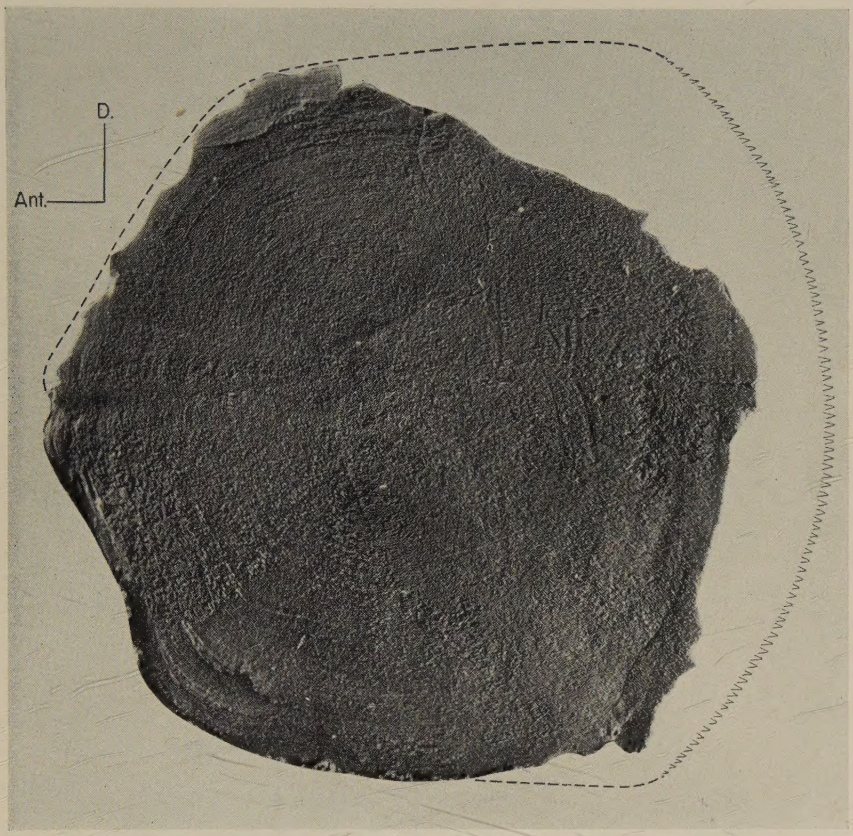
Remarks: The scale characteristics of *Paractichthys* are more comparable to those of anacanthine fishes than to any other living group (David, 1956). While very probably not closely related to any extant member, all features exist in one or another genus of the Gadidae. It is upon this basis that the family assignment has been made. Heretofore, the codfishes and their allies have been recognized only from marine sediments of Tertiary age. *Paractichthys*, thus, extends the known geologic range of the gadid fishes into the upper Cretaceous, and the genus may prove, on recovery of more complete remains, a key to the establishment of the complete phyletic history of this distinctive assemblage of fishes.

III. Comments on the Status of *Cyclolepis stenodinus* Cockerell

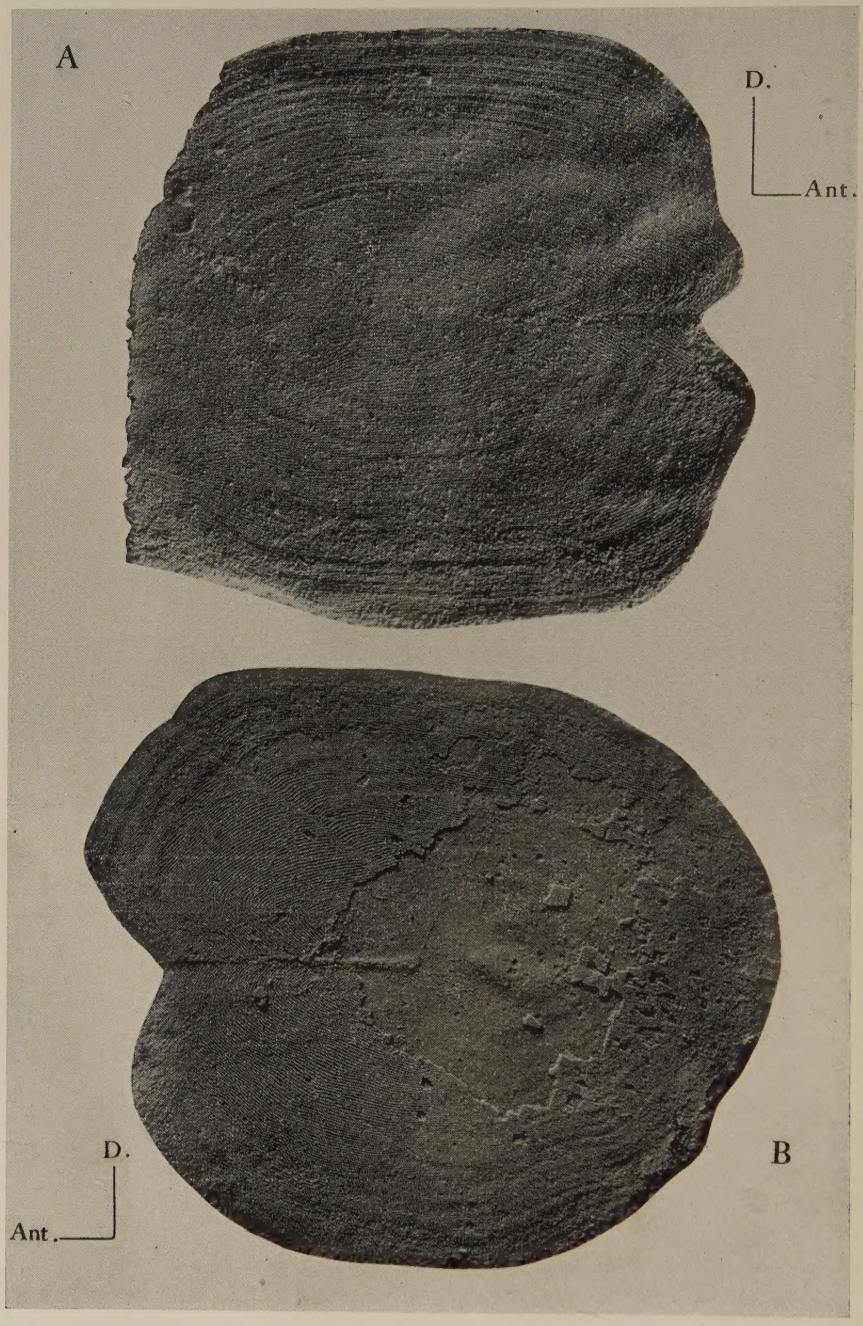
Plate 3

The genus *Cyclolepis* was named and described by Geinitz (1868). The genotypic species, *C. agassizi*, is based on unassociated scales from the Pläner formation (Cenomanian and Turonian) of Saxony, which display a subcircular or ovate outline with nearly central nucleus, concentric circuli, and an absence of either radii or ctenoid structures. Although various opinions have been held regarding the affinities of the form, most current classification outlines list *Cyclolepis* with the salmonoid fishes (Romer, 1945; David, 1946).

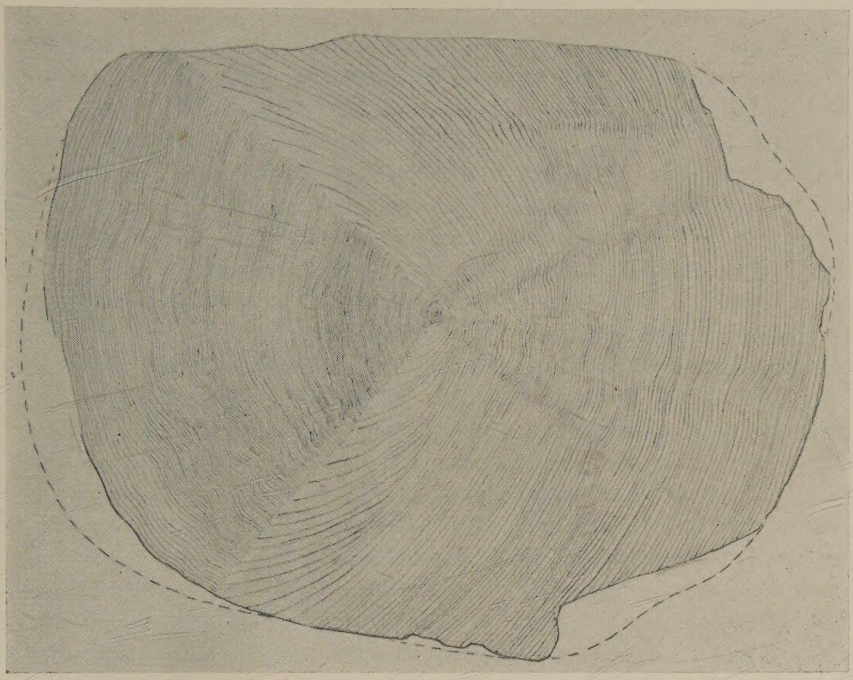
In 1919, Cockerell described an isolated scale from the upper Maestrichtian (Fox Hills sandstone) of Colorado under the name *Cyclolepis stenodinus*. The Cockerell type (USNM 8703) is exposed in internal aspect, displaying prominent annular growth rings, and as thus observed would appear to compare closely with the characterization of *Cyclolepis* Geinitz. However, recent examination under highly refractive liquids and the binocular microscope has revealed previously unreported features of the embedded external surface of the scale. The new information creates serious doubt as to the correctness of the generic reference and even as to the validity of the Colorado species.



Photograph of type scale *Helmintholepis vermiculatus* Cockerell (1919), herein reassigned to *Apsopelix berycinnus* (Cope), with missing margins restored. Reproduction approximately × 4. Explanation of abbreviations: ANT, anterior; and D, dorsal.



Paractichthys fibrillatus (Cockerell). Scales (A, USNM 8662 TYPE; B, USNM 14517) from the upper Cretaceous Blair formation in Sweetwater County, Wyo. Reproduction approximately × 10. Explanation of abbreviations: ANT, anterior; D, dorsal.



Holotypic scale of *Cyclolepis stenodinus* Cockerell (USNM 8703). Specimen, presumably from right flank of fish, drawn with anterior basal edge oriented to the right; external surface ornamentation somewhat diagrammatized, and small vertical striae between circuli omitted. (Magnification × 9.)

The original description of *Cyclolepis stenodinus* now may be expanded. A relatively thin scale of moderate size (measurements, in millimeters: 12.4 long by 9.7 deep). In outline, subcircular with broadly rounded and confluent dorsal, apical, and ventral margins; obtuse but distinct basal angles; and a centrally lobed basal edge. Perpendicular of maximum depth adjacent to the basal angles and thus situated far anteriorly. Nucleus a concentrated focus both internally and externally, slightly apicad of central. No basal or apical radii, but suggestive of the former are several (three or more) indistinct folds or undulations in the courses of the circuli across the central part of the basal field, arranged in lines convergent posteriorly toward the nucleus. Circuli on anterior inserted portion of scale coarse (18 in 1 mm. centrally and 12 in 1 mm. peripherally above and below, and in their posterior zone of termination along the apical diagonals); essentially vertical in arrangement although slightly curved in an anterior direction around the nucleus and bent posteriorly both along the ventral basal diagonal and in an upper peripheral zone so that the dorsal ends of the lines intersect the scale margin at more acute angles than do the ventral ends. Interspaces between the more widely separated circuli of the dorsal and ventral quadrants marked by short, fine, parallel striae (10 to 12 in 0.1 mm.), directed at acute angles to the circuli and generally perpendicular to the anteroposterior axis of the scale. Apical field triangular with a nuclear angle of about 101°; ornamented with fine circuli (34–36 in 1 mm.) arranged in parallel but slightly undulating crescentic courses to meet the terminations of the basal circuli along the apical diagonals in angles of approximately 90°. Internal surface of scale distinctly marked by sparsely tuberculous and concentric annular growth rings which are in places so closely set they resemble concentric circuli.

No materials of the genotypic *Cyclolepis agassizi* are available for comparison. Notwithstanding, the characteristics of the scale of *Cyclolepis stenodinus* are not those either commonly or easily associated with the scales of salmonoid fishes. Rather, scales of its type with essentially vertical circuli which are coarser in the basal portion than in the apical one and with nearly central nuclei are better recognized as pertaining to the Synentognathi, Scombroidea and Carangoidea. During search among these latter groups for more closely comparable materials, striking and fundamental similarities were observed between *C. stenodinus* and *Hemilampronites hesperius* Cockerell (1919). In fact, only minor differences of shape, absolute size, and slight details of sculpture exist between the two species and these are well within the range of variation to be expected between scales from different parts of the body of one fish. Interestingly also, the

holotype of *H. hesperius* (USNM 8713) and that of *C. stenodinus* were both collected by T. E. Willard of the U. S. Geological Survey on Sept. 14, 1914, from the same exposure of Fox Hills sandstone in sec. 23, T. 4 N., R. 67 W., southwest of Milliken, Weld County, Colo. It is concluded that *Cyclolepis stenodinus* is a synonym of *Hemilampronites hesperius*.

Cockerell (1919) referred *Hemilampronites hesperius* to the Hemiramphidae. Such a relationship is indeed supported by the centrally lobate basal border and the marked angle of meeting of the apical and basal circuli displayed by the scales. As remarked by David (1946) in another case, however, the proportionately long, broadly rounded outline and lack of discrete basal radii suggest relationship also with either or both the Scomberesocidae and Exocoetidae, among other Synentognathi. This distinctive combination of structural features, which serves adequately to separate the Cretaceous species from the Tertiary and living members of the order, may well indicate a primitive ancestral type. Unfortunately, the fossil record of the flying fishes and their allies is meager. Until available information permits reconstruction of the evolution of the order, no precise designation of the relationships of *H. hesperius* seems feasible.

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